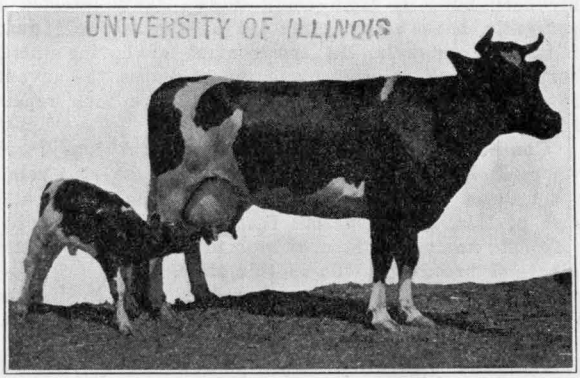
Answers to Questions Regarding Bovine Infectious Abortion

By Robert Graham and Frank Thorp, Jr.



To yield the greatest profit, a herd must consist of healthy, nonreacting, normally breeding cows. Animals that abort or suffer from any contagious disease are potentially dangerous to the health of the herd.

UNIVERSITY OF ILLINOIS
COLLEGE OF AGRICULTURE AND AGRICULTURAL EXPERIMENT STATION

Circular 360

NO INFECTIOUS disease of cattle appears to be more widely distributed in Illinois than bovine infectious abortion. In testing more than one hundred Illinois herds in thirty-five counties in 1928, veterinarians cooperating with the Laboratory of Animal Pathology and Hygiene of the University of Illinois found that one animal out of every five reacted to the blood test for this disease. Previous and subsequent tests in other herds have shown a similar proportion of infected animals. Apparently about 20 percent of the cattle in Illinois are infected.

Herds found free from infectious abortion have invariably been built up from small units. Badly infected herds apparently have become infected by the frequent purchase of infected animals. In the control of bovine infectious abortion as well as other contagious diseases, the advantages of raising replacements for the herd have been repeatedly proved.

Conservative estimates place the total loss to cattle owners in Illinois as a result of this disease at a minimum of 5 million dollars annually. Whether the loss is actually more or less, it is apparent that bovine infectious abortion represents an important economic problem facing owners of dairy and breeding herds in this state.

This circular has been prepared in order to disseminate more widely facts concerning the nature of the disease and to describe a plan that breeders may employ for its suppression and prevention. This plan of control consists of testing the herd for Bang disease, isolating or disposing of reactors, and the employment of sanitary measures based upon knowledge of the ways in which the disease spreads.

Urbana, Illinois October, 1930

Answers to Questions Regarding Bovine Infectious Abortion

By Robert Graham, Chief in Animal Pathology and Hygiene, and Frank Thorp, Jr., Assistant

EXPERIENCE gained during the past eight years in cooperating with herd owners and veterinarians has demonstrated that infectious abortion of cattle can be controlled in many herds by testing to detect infected animals and following the test with a program of herd management designed to eliminate reacting animals and to prevent infected animals from entering the herd.

More than three hundred and sixty owners in sixty-eight counties of Illinois have voluntarily enrolled their herds in the cooperative project[1] outlined by the Illinois Agricultural Experiment Station to study the practicability of abortion-disease control. The herds enrolled at the present time include approximately 10,600 cattle. A limited number of new herds will be accepted from time to time for study in this project in cooperation with the local veterinarian, on the written request of the owner.

Under the Illinois plan animals that react to what is known as the "agglutination test" are ultimately removed from the herd or placed in temporary isolation at calving time. The owner decides how reactors shall be disposed of. While prompt elimination is recommended, yet temporary isolation of reactors has proved effective in suppressing the spread of the disease in many small herds. In fact several infected herds operated at a loss have been cleaned up by testing and temporary isolation. Keeping infected animals on indefinitely in a herd, however, is likely to prove more expensive than their prompt disposal, even where the number to be disposed of is large.[2]

Twenty-one dairymen and breeders have already received abortion-free accredited herd certificates from the Chief Veterinarian of the Illinois State Department of Agriculture, Springfield. Many other herds, including all state-owned herds, are making satisfactory prog-

[1]See page 26 for copy of the project. The essentials of the Illinois plan were first advocated by Dr. M. F. Barnes of the Pennsylvania Bureau of Animal Industry.

[2]The number of dairy cows and heifers over two years of age in Illinois was estimated by the U. S. Department of Agriculture as one million in 1927. On the basis of a 10-percent infection, the actual loss from contagious abortion approaches 5 million dollars annually; this includes an estimated underproduction of milk and calves amounting to $25 a year for each infected cow. Actual tests of herds suggest that a 20-percent infection may more accurately represent the extent of the disease.

ress toward accreditation. The basis of accreditation is two annual negative tests of all animals in the herd over six months of age.

The principal need in suppressing or preventing the spread of the disease in infected herds is not elaborate equipment or expensive isolation quarters but more definite knowledge of the nature of the disease, on the part of the owner, and appreciation of the value of simple preventive measures, as well as a willingness to apply them. The precise measures to be employed in a herd depend on the extent of the disease, the value of the animals, and the equipment available. The Illinois plan, tho not recommended as perfect, can be and has been successfully blended with the management of many different dairy and beef cattle herds. Each herd, however, presents a specific problem, which may require the counsel and advice of the local veterinarian if best results are to be obtained.

On the basis of experience to date it appears that there is nothing to be gained in the control of infectious abortion by feeding minerals or medicine.

NATURE OF INFECTIOUS ABORTION

What is meant by abortion? Abortion is the expulsion of a dead or an immature fetus. Abortion may be due to a number of different causes. The recognized causes include bacterial infections, injury, violence, illness accompanied by high fever, improper rations, and probably poisonous or toxic weeds.

What is bovine infectious abortion? Bovine infectious abortion is a specific disease characterized by inflammation and necrosis, or death, of the fetal and maternal placenta. The destruction of the placental union on the surface of many cotyledons retards the nourishment of the fetus. Advanced cases of cotyledonitis (diseased cotyledons) culminate in the expulsion of the fetus. Mild cases of cotyledonitis involving a few cotyledons may occur unaccompanied by the act of abortion. Reference to Figs. 1 to 3 will indicate more clearly how the fetus is affected by this disease.

Why is bovine infectious abortion commonly referred to as Bang bacillus disease? The name "Bang disease" comes from the discoverer of the microorganism that causes cattle to abort. Careful investigations have shown that the microorganism isolated by Professor Bang of Denmark in 1896 is an important factor in the widespread abortions in the United States.

The work of Professor Bang of Denmark was confirmed at the Illinois Agricultural Experiment Station in 1912 by McNeil and workers associated with him. Investigations conducted by the Federal Government and various state experiment stations have since shown that the Bang type of the disease exists in the principal dairy and cattle-raising districts of the United States.

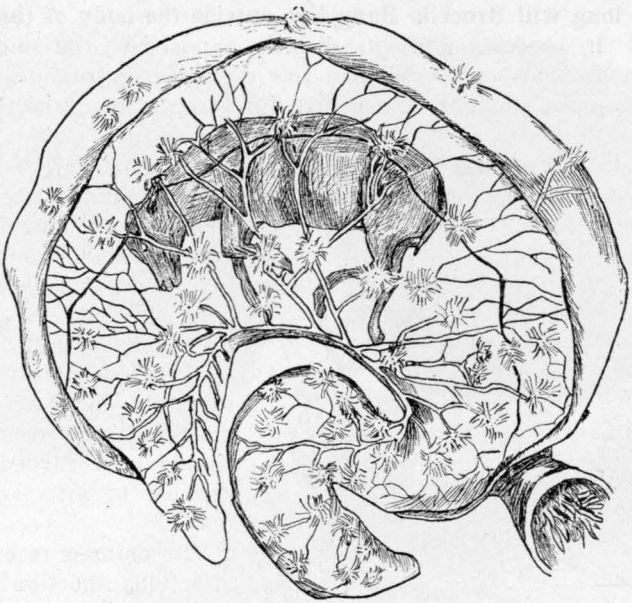


FIG. 1.—FETAL CALF IN UTERUS

The fetal calf within the uterus is surrounded by several membranes. The inner, or amnion, layer is nearest the fetus and forms a closed sac around it filled with a fluid in which the fetus floats. The central, or allantois, membrane is composed of two layers which form a closed sac in connection with the tube which extends from the fetal bladder thru the umbilical cord, and contains allantoid fluid. The outer membrane, or chorion, completely incloses the fetus and its other membranes. On the outer surface of the chorion membrane are found the fetal cotyledons. Thru the attachment of the fetal and maternal cotyledons nourishment is furnished to the fetus.

For many years it was not known that the Bang bacillus was related to *Brucella melitensis* of goats, which causes Malta fever in man. Recent investigations have shown that the cattle and goat microorganisms are closely related. Much confusion exists among scientists concerning the proper name for the bovine organism; it is known as Brucella Bang, *Bacterium abortum* Bang, *Bacillus* Bang, etc. The name "Brucella Bang" will be used in this circular.

Is there any variation in virulency among different strains of Brucella Bang? Yes. The different course which the disease takes in different herds is due probably to a variation in the virulency of the strain. It is also known that the goat and swine strains often prove more virulent in the human host than some cattle strains.

In what part of the infected cow is Brucella Bang found? The Brucella Bang organism is found in the pregnant uterus and in the mammary glands, or udder. Occasionally the reproductive organs of bulls also harbor the infection.

How long will Brucella Bang live outside the body of the infected animal? In pastures and lots directly exposed to the sunlight the organism probably survives but a few days. If the organism is protected from the sunlight, it may live for three to six months or even longer.

Is there any natural immunity to infectious abortion? Some cows possess resistance to the disease under ordinary methods of exposure; in fact some animals remain free from abortion even tho kept in infected herds. Unfortunately the percentage is low, and natural immunity is therefore of little practical value in controlling the disease. All pregnant cows should be regarded as susceptible to infectious abortion.

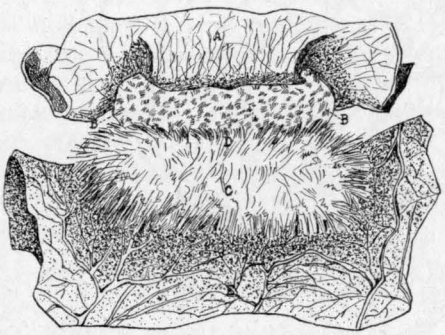


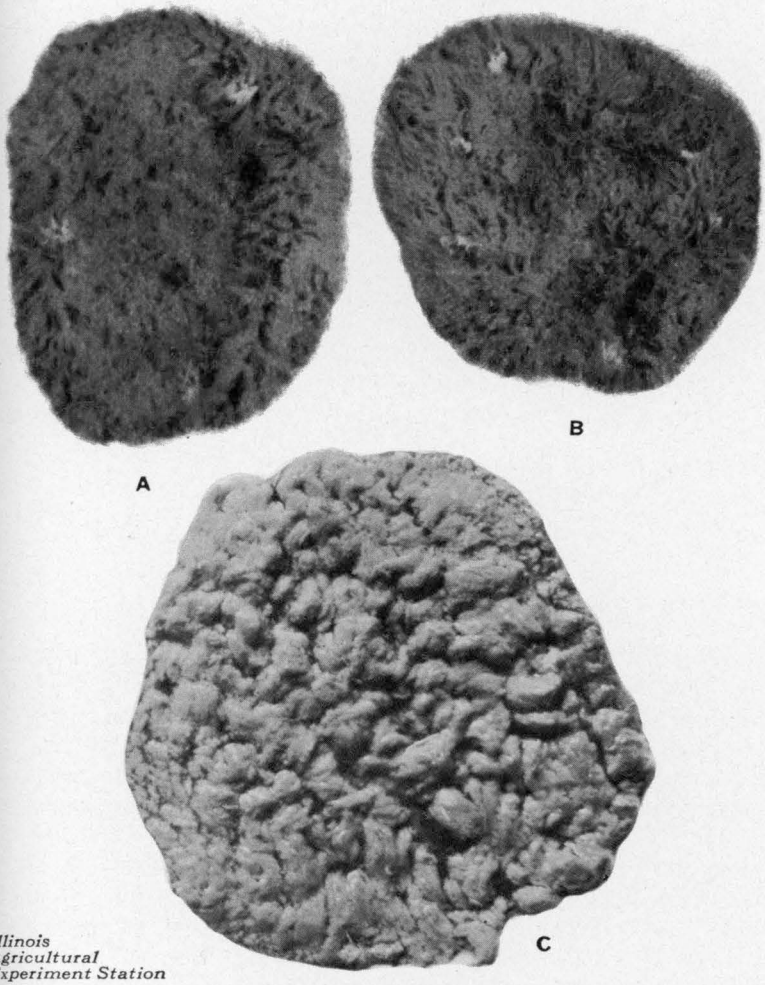
FIG. 2.—FETAL AND MATERNAL COTYLEDONS

A portion of the uterus (A) is shown with the maternal cotyledon (B) attached to it. The fetal portion (D) consists of a mass of very minute hair-like processes on the chorion (E), which fit into the corresponding depressions or pits of the maternal portion. Each portion is abundantly supplied with blood vessels, so that a ready interchange of nutritive fluid may take place between mother and fetus.

Do animals recover from infectious abortion? Mature animals or animals of breeding age seldom appear to recover from this disease. Animals that have reacted and later given negative tests may not remain negative. To avoid being misled regarding the presence or absence of the disease it is advisable to regard breeding animals that have given a clear-cut reaction to the agglutination test as permanently infected. Reacting calves, however, that receive milk from infected animals generally make a complete recovery. Breeding cows infected with abortion may ultimately become sterile instead of developing a tolerance to Brucella Bang, or they may breed normally for years.

Is it safe to assume that a herd is free from infectious abortion when animals that have aborted calve normally? No. Animals that abort and later breed normally are often infected. The delivery of normal calves by infected cows is commonly mistaken for complete recovery. Storms of abortion frequently occur in herds of this character and abortions may persist in the heifers. Reactors that calve normally may spread the infection at calving time.

Is there any condition in the afterbirth that suggests the presence of Brucella Bang? Yes. A yellowish discoloration of the cotyledons



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FETAL COTYLEDONS SHOWING INFLAMMATION AND NECROSIS IN EARLY AND LATE STAGES OF INFECTION WITH THE BANG ABORTION ORGANISM

The yellowish spots in *A* and *B* are the beginning of the infection which leads to the expulsion of the fetus, or abortion. These yellowish areas may increase in size until they involve the entire cotyledon as in *C*. Animals with mild infection of the cotyledons sometimes carry the fetus full term. When the disease is advanced, as in *C*, the cotyledons fail to function in the nourishment of the fetus, and the fetus is aborted. Cotyledons vary in size, being both smaller and larger than the above. Necrosis due to infection of cotyledon should not be confused with normal disintegration and yellow color of cotyledons in normal calving.

FIG. 3.—AN ABORTION-INFECTED CALF

Abortions may occur at any period of pregnancy, but a majority of cows abort from the Bang type of the disease during the seventh month. There are no lesions which mark or distinguish the infectious Bang type from abortions due to other causes.

is suggestive of Bang infection, tho it does not furnish an absolute basis for diagnosis since cotyledons may become yellowish or necrotic from other causes.

METHODS OF SPREAD

How is bovine infectious abortion introduced into a herd? The purchase of infected cows is usually responsible for the introduction of the disease into a herd. Bulls harboring an infection in the genital tract are also potential spreaders at the time of service. Such bulls may bring infection into clean herds, but outbreaks of the disease are more often traceable to the purchase of infected but normally breeding cows (Figs. 4 and 5).

How does Brucella Bang spread within a herd? The most dangerous period of spread is at the time of calving or aborting. Pastures, yards, or stables where infected cows have calved or aborted become contaminated from infected afterbirths and uterine discharges. The discharge of Brucella Bang from the uterus is more abundant than from the udder and therefore more dangerous in perpetuating the disease. The infection about the premises ultimately contaminates the feed and water, and susceptible animals become infected thru the mouth. Investigations in recent years have tended to minimize the importance of the bull as a spreader of infectious abortion except in cases where bulls serve discharging infected cows and transmit the disease mechanically or as the result of a specific genital infection.

Is drainage water a factor in spreading infectious abortion? Clinical evidence submitted by veterinarians and herd owners tends to support the supposition that the abortion organism may be spread from one pasture to another in the drainage water. Difficulty has been

reported in maintaining clean herds that receive drainage from infected pastures. The danger of spread by this method is obviously

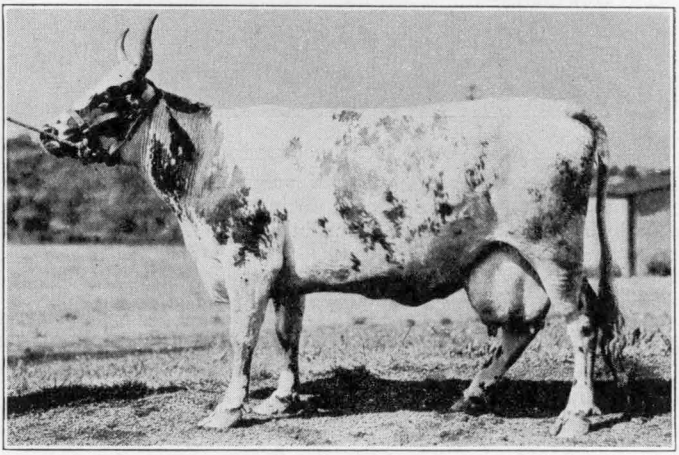

FIG. 4.—ABORTION REACTORS MAY BREED NORMALLY

The above animal was born in December, 1919, and dropped her first calf in April, 1922, and a calf each year thereafter until and including March, 1925. In April, 1925, she contracted abortion disease, and altho giving repeated positive tests, she dropped a normal calf on May 5. Cows of this type, infected with abortion yet with favorable breeding records may be kept in temporary isolation without incurring an unusual risk.

influenced by the number of infected animals that are discharging the abortion infection where it will get into the drainage water and be carried to adjacent pastures.

What is a "spreader" or "carrier" of abortion disease? A spreader or carrier is merely an infected cow or bull that scatters infection. The agglutination test will detect carriers.

How do bulls spread abortion disease? A nonreacting bull bred to an infected discharging cow may passively carry the infection on the reproductive organs to a clean animal. The danger of nonreacting bulls spreading abortion can be reduced to a minimum by breeding only nondischarging healthy cows. For further information concerning the role of the bull as a carrier of infection see page 11.

Does Bang disease spread thru milk? Infected cows may give off Brucella Bang thru milk for many years. Young calves drinking milk from infected cows appear highly resistant to the disease, tho they

may, while drinking milk, give a positive reaction to the agglutination test and pass Brucella Bang in their feces. Only occasionally do they contract a permanent abortion infection.

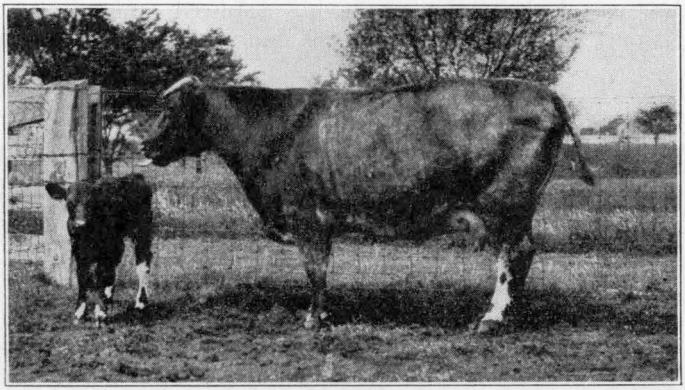

FIG. 5.—BEEF CATTLE AS WELL AS DAIRY CATTLE SUFFER FROM INFECTIOUS ABORTION

Tho an abortion reactor, this animal has a relatively clean breeding history. Born November 21, 1920, this cow calved normally in 1923, 1926, 1927, and 1928. The 1925 and 1929 calves were dropped one month before they were due. A breeder attempting to eradicate infectious abortion by disposing of aborters often fails to detect the mildly infected, normally breeding animals, which are capable of spreading the disease at calving time.

What is the explanation of a sudden outbreak of abortion in a herd where there have been only a few abortions? There is always a possibility of an abortion storm in herds harboring potential spreaders. If infected animals discharge the infection and it is picked up by susceptible pregnant animals, a series of abortions may occur.

MAINTAINING ABORTION-FREE HERDS

How can an owner maintain a clean herd when other herds in the community are infected? If clean and infected animals do not have actual contact with the same pasture, and if the bulls in the clean herd are not used on cows in infected herds, herd-to-herd infection will not usually be found a serious problem unless natural drainage from infected to clean pastures occurs.

Do cows suffering from infectious abortion acquire immunity? No, not in the true sense of immunity. Infected animals may acquire a tolerance to the disease and calve normally. This fact, however, is not reliable evidence of recovery. Most infected animals of breeding age

should be regarded as potential spreaders of the disease thru their milk or thru vaginal discharge at calving time. The tolerance which some animals acquire is therefore of little practical value in building up a herd resistant to abortion. As a matter of fact, animals that are sometimes looked upon as having acquired immunity, which in reality is only a tolerance, are the most dangerous spreaders of the disease.[1]

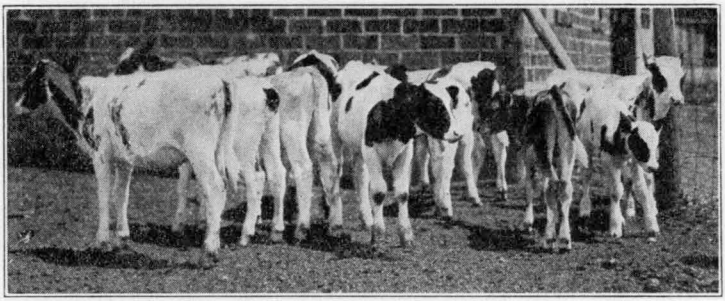

FIG. 6.—CLEAN CALVES BEING REARED FROM REACTING AND NONREACTING COWS

In the suppression of abortion disease it is important that young calves be kept separate from mature susceptible cows. Calves receiving milk from infected cows may be the means of spreading infection to susceptible breeding animals in pastures. Young calves are highly resistant to abortion disease and if they contract it, will generally become free from it in less than 90 days after the milk-drinking period.

Should calves in infected herds be fed pasteurized milk in order to avoid exposing them to Brucella Bang during the milk-drinking period? The safest practice consists of feeding pasteurized milk, but if raw milk from an abortion-infected herd is fed, the infection as judged by the agglutination test generally disappears a few weeks following weaning. Abortion infection in heifers traceable to a calfhood infection is possible but apparently occurs in only a small percentage of cases.

How should calves receiving infected raw milk be managed? When raw infected milk is fed to calves, the droppings are potentially dangerous in spreading the disease. It is therefore necessary to keep calves receiving infected raw milk in separate quarters, and for ninety days after the feeding of infected milk is discontinued they should not

[1]In one herd made up entirely of reactors, breeding and calving records over a period of five years show that 25, or 39 percent, aborted once; 4, or 6.25 percent, aborted twice; 4, or 6.25 percent, aborted three times; and 1, or 1.4 percent, aborted four times.

be allowed in pastures used by mature animals or animals approaching breeding age (Fig. 6).

In gradually building up an abortion-free herd, how should calves from reacting cows be handled? Calves from reacting cows should be fed pastuerized milk when possible, and should be kept away from quarters occupied by pregnant heifers and breeding cows.

Should calves from reacting cows be allowed the first milk, or colostrum? Yes, because calves fed in this way are more resistant to a fatal form of white scours. Calves not receiving colostrum are unusually susceptible to intestinal infections. After the first week pasteurized milk or milk from nonreacting animals should, if possible, be fed to calves from reacting cows.

Is it advisable to use a community bull? Yes, if the bull is healthy and is used only in healthy herds. The possibility of spreading breeding troubles is intensified by using community bulls in both infected and clean herds.

Are bull sperm cells susceptible to disease? Yes. Disease is indicated by ill-shaped or dead spermatozoa. An abundance of pus cells and pyogenic bacteria may also be found in the semen of infected sires.

Are infected bulls a menace to a herd? Yes. They not only fail to settle cows, but they may spread infection, causing early abortion and breeding diseases which terminate in sterility.

How can bulls infected with breeding diseases be detected? Microscopic examination of the semen at time of service will disclose infection. The motility and shape of the sperm cells, together with results of bacteriologic examinations, are fairly reliable guides of breeding health. Trained veterinarians should be employed for this work.

Should nonreacting bulls be allowed to serve both reacting and nonreacting cows? This practice is followed in herds enrolled in Project 1046 (see page 26). So far there has been no evidence of a nonreacting bull acting as a spreader. Several days, however, should elapse between serving a reacting and a nonreacting cow.

Should reacting bulls be used for breeding purposes? No. There is danger of a localized infection of the reproductive organs, which renders the animal a potential spreader of abortion infection.

LOSSES TO BREEDERS

How does bovine infectious abortion cause loss to breeders? The death of calves and the birth of weak calves that may die of pneumonia are important causes of losses to breeders. Calves in abortion-infected herds may also prove unusually susceptible to calf scours.

These diseases are not caused by the abortion microorganism, but lowered vitality from abortion infection makes calves more susceptible to these infections. The low milk yield of aborting cows is also a common source of loss. Retained afterbirth is a common complication that terminates in sterility and breeding losses. Garget or inflammatory

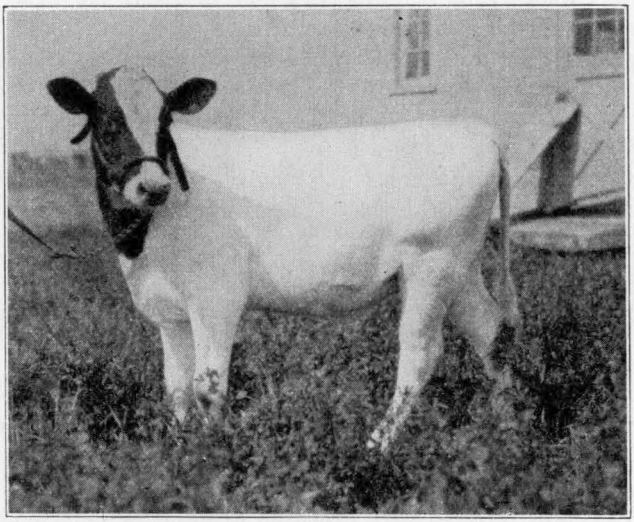

FIG. 7.—A NONREACTING UNBRED HEIFER FROM AN ABORTION-FREE HERD

In the building of a herd free from abortion it is safer to buy unbred heifers subject to the abortion test than any other animals. In fact unbred heifers if kept in separate quarters and away from infected animals seldom become carriers of abortion disease.

conditions of the udder marked by clotty or bloody milk are frequent complications in abortion-infected animals. All these factors, tho some are only indirectly associated with bovine infectious abortion, contribute to the total losses. Herds badly infected with Bang disease are ultimately maintained at a loss and breeders frequently become discouraged and sell out.

How can bovine infectious abortion be avoided in the purchase of breeding stock? In buying foundation stock, unbred heifers that are negative to the agglutination test are least likely to introduce abortion infection (Fig. 7). If bred cows or heifers are purchased, they should be held in isolation until after calving and after being found negative to the agglutination test.

How have clean herds been developed? Invariably clean herds have been developed from small units by cautious buying, by discontinuing outside breeding, by purchasing only unbred negative heifers or negative mature cows from herds free from abortion, and by the application of sanitary measures.

STERILITY FOLLOWING ABORTION

How serious a factor is sterility following abortion? Sterility resulting from contagious abortion varies in different herds. In one group of 16 infected cows there was, over a period of four years, a yearly average of 6 cows that proved sterile, or an average of 39 percent each year. Seven cows calved normally each year; in other words, approximately 44 percent proved normal reproducers as judged by delivery of live calves. An average of about 3 abortions, or 17 percent, occurred yearly. Sterility in this herd was thus more costly than abortion, notwithstanding that all animals suffered from the infection. Sterility is frequently associated with a variety of pus-producing bacteria which gain a foothold after the abortion infection has done its damage. In another herd of reacting cattle 29, or 45.3 percent, of the herd became sterile over a period of five years, while a smaller percentage of the animals in this herd actually aborted.

Is sterility in cattle always traceable to a primary infection of Brucella Bang? No. Animals may become sterile from other causes. Pus infections in the genital tract have been encountered frequently in sterile animals that gave repeated negative reactions to the agglutination test for infectious abortion.

Are these pus infections communicable thru the bull? The clinical evidence suggests that the bull may be a factor in transmitting certain pus infections which render cows sterile. Experimentally these infections have frequently proved of low virulency and have been reproduced with difficulty under laboratory conditions.

What are the conditions that lead up to pus infections of the genital tract? Retained afterbirth, which occurs frequently in herds harboring infectious abortion, is probably one of the most common causes.

ABORTION REDUCES MILK FLOW

How does abortion interfere with milk yield? The normal stimulus to milk flow that occurs after normal calving does not follow an abortion. The effect of abortion on milk yield is shown in Fig. 8. In a period of ten months following two normal calvings, milk yields of 6,235 pounds and 5,220 pounds were attained. After two abortions, milk yields amounted to 4,220 pounds and 2,805 pounds.

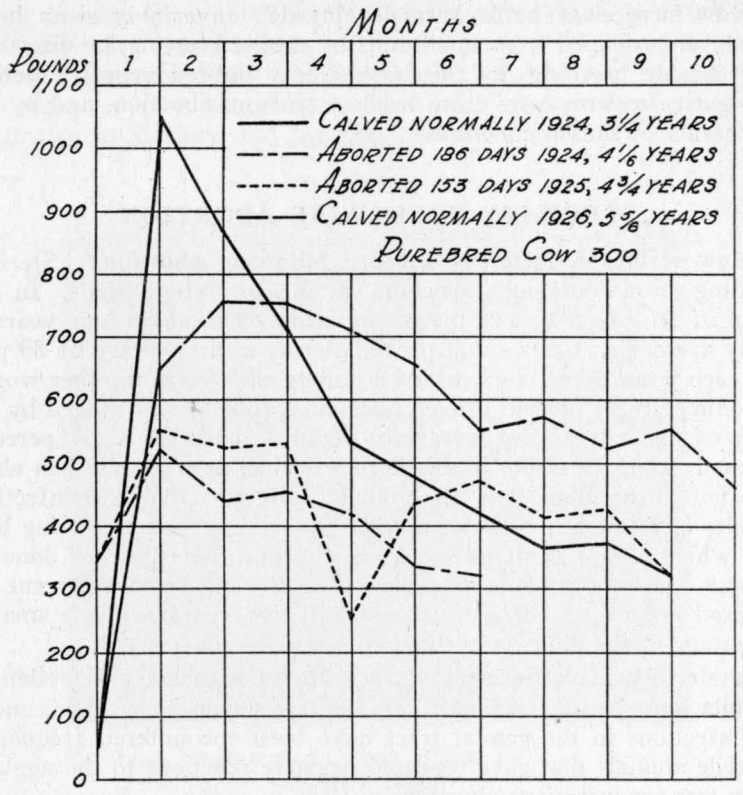

FIG. 8.—EFFECT OF ABORTION ON MILK FLOW

The above diagram shows the monthly milk flow in pounds from a cow following normal calving and abortion. The records are based on a period of ten months dating from time of calving or abortion.

What does the average reduction in milk yield traceable to abortion amount to in money? At a market price of $2.55 a hundredweight the value of the milk yield following the two normal calvings mentioned in the preceding paragraph was $158.99 and $133.11 respectively, while after the two abortions the milk was worth $107.61 and $71.53. Thus there was an average loss in milk yield of $56.48 after each abortion.

Normally calving cows in another herd yielded an average daily milk return over aborting cows of 18+ cents a day, $5.40 a month, or $54 for a ten-months' lactation period at the prevailing price of $2.55 a hundred pounds for market milk. Stated in another way, the average milk loss annually in aborting animals in this group over a period of four years approximated $54, not to mention the loss of the calf or

the danger of sterility incurred thru abortion infection. The normally calving cow gave an average of 113.3 gallons, or approximately 906.4 pounds a month, while the average aborting cow gave 88.5 gallons, or approximately 708 pounds a month.

The average milk yield following 28 normal calvings and 11 abortions in 16 animals of comparable milking quality during a period of four years is illustrated in Fig. 9.

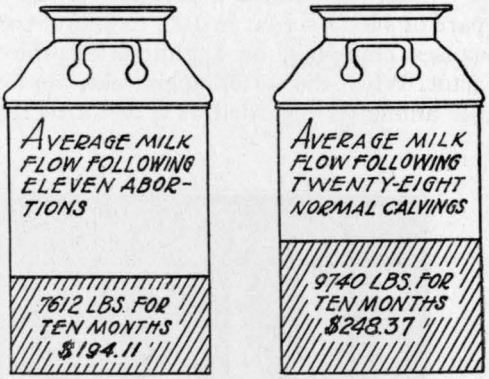

FIG. 9.—AVERAGE MILK FLOW FOLLOWING NORMAL CALVING AND ABORTION

The average milk flow following 28 normal calvings and 11 abortions in 16 animals of comparable milking quality is illustrated diagrammatically in the amount of value of milk over a period of four years from aborting and normally calving animals.

Is the milk yield reduced in all aborting animals? The milk yield following an abortion varies with each animal. The time during gestation at which the abortion occurs, as well as the normal producing ability of the animal and the rations fed, influences the amount of milk produced. The stimulus appears to vary in direct proportion to the age of the aborted fetus. Thus a fetus aborted at two months stimulates milk yield but slightly. As the fetus develops, the stimulus following its delivery increases until the maximum milk yield is attained following normal calving.

THE AGGLUTINATION TEST

What is the agglutination test for Bang bacillus disease? The agglutination test consists of mixing in a weak salt solution, a suspension of the organism that causes infectious abortion (Brucella Bang) with varying amounts of blood from a suspected animal. The saline bacterial suspensions containing blood serum are then incubated for several hours at body temperature. Blood serum from normal cows has no effect on the bacterial suspension, but blood serum from infected cows, in relatively small amounts, will cause it to clump, the agglutinated bacteria collecting in the bottom of the test tube.

Is the agglutination test reliable? In the experience of the authors the agglutination test is a reliable diagnostic agent in skilled hands. Experience in testing several thousand animals appears to justify the

belief that it is as reliable a diagnostic agent as the tuberculin test. Irregularities or failures attributed to the test are often explained on the ground of manipulation. The test is not perfect but it is sufficiently accurate to serve as a basis for establishing clean herds.

What constitutes a reaction to the agglutination test? When 1 part of blood serum in 100, or more, parts of the bacterial suspension causes clumping, or agglutination, the animal is regarded as a reactor. When the serum agglutinates in lower dilutions, such as 1 to 50, the animal is regarded as a doubtful reactor.

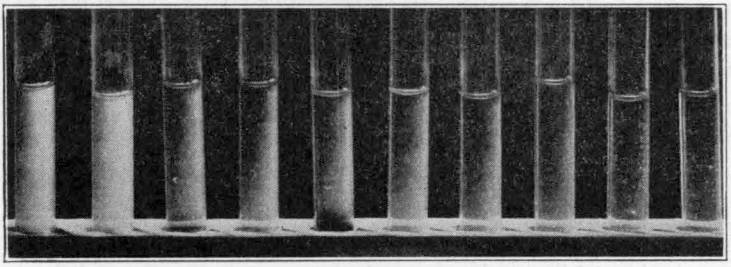

FIG. 10.—REACTION TO THE STANDARD AGGLUTINATION TEST

The tubes pictured above contain a suspension of Brucella Bang in physiological salt solution. Serum from cows giving positive reactions to the test has been added to the 8 tubes to the left. Serum from negative cows has been added to 2 tubes on the right. The clumping of the bacterial suspension is visible to the naked eye. No other agent will produce clumping except the specific antibodies in the blood of infected cows or cows that have been vaccinated.

What is meant by the standard tube and rapid plate agglutination tests for abortion? The standard test (Fig. 10) requires an incubation period of 24 to 48 hours. The rapid method is dispatched in 10 to 20 minutes by mixing the proper amount of blood serum and a concentrated suspension of Brucella Bang in salt solution. The clumping occurs in a few minutes if the animal is infected (Fig. 11). Milk serum can be used in either the rapid or the standard test instead of blood serum, but it is not more than 50 percent accurate as judged by comparison with the results from the use of blood serum.

Which test is the more reliable? If the two tests are accurately dispatched, the results check very closely. Samples showing doubtful reaction to either test should be carefully retested. Of 4,834 blood samples tested by the rapid and slow methods from January to July, 1929, 939 or 19.42 percent proved positive; 324 or 6.7 percent, doubtful; and 3,571 or 73.8 percent, negative to the rapid method. The same samples when tested by the standard method showed 1.5 percent

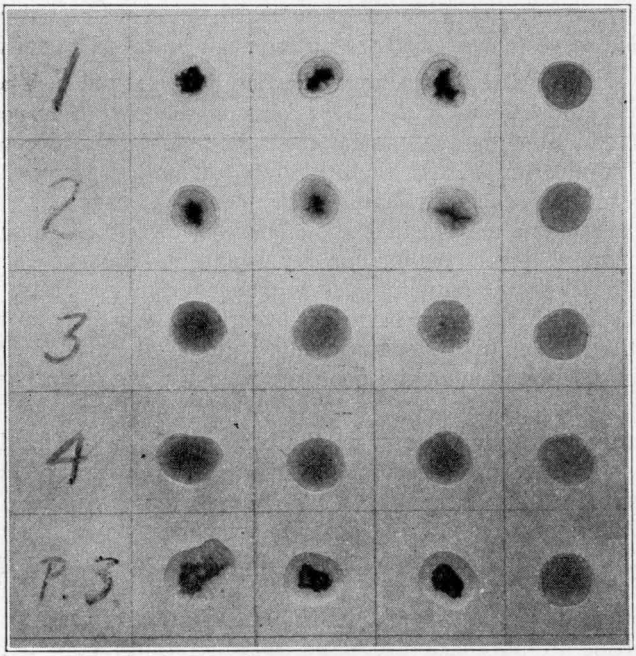

FIG. 11.—THE RAPID AGGLUTINATION TEST

Samples 1 and 2 show distinct agglutination in dilutions of .02, .01, and .005. Samples 3 and 4 are distinctly negative. Note that Samples 1 and 2 show clumping like the serum known to be positive ("P. S."). The samples in the column to the right are controls to which known negative serum has been added; no clumping or agglutination occurs in these.

fewer positives, .2 percent fewer doubtfuls, and 1.2 percent more negatives. Stated in another way, the variation observed on approximately 5,000 samples proved negligible.

What has the agglutination test shown with respect to abortion-free herds in Illinois? The evidence suggests that there are many herds practically free from abortion disease. The only sure way to establish that a herd is free from abortion is by testing.

Do repeated agglutination tests influence the results of subsequent tests? No. One test has no effect on other tests.

Should a breeder who has had no abortions in his herd in recent years test his cattle? Yes. Any herd may contain a few animals capable of spreading infection. Often ridding the herd of normally breeding reacting animals will prevent subsequent abortion losses. If temporary isolation is practiced and a few reacting animals are kept in

the herd, it is an advantage to know which ones are actual spreaders of the disease so that special precautions can be taken at calving time.

How successful has the agglutination test proved? The results obtained in approximately 200 herds during the past four years indicate that abortion disease can be controlled in mildly infected herds thru the application of the agglutination test and the proper disposition of reactors (see items 2 and 3, Project 1046, page 26). Furthermore, it has been observed that abortion-disease control is not dependent upon an elaborate equipment for isolation. Meager facilities to isolate animals have been employed with encouraging results. In some instances stalls in the same barn have been partitioned from the main part of the stable to prevent reacting animals at calving time from spreading the infection in the pastures used for the main part of the herd.

Is it safe to purchase cows on the basis of the agglutination test? Yes, provided the entire herd from which the animals are purchased give negative agglutination tests. A common error is made in purchasing individual nonreacting animals from herds which contain reactors. Some of the nonreacting animals at the time of purchase may be incubating the infection but not reacting. These animals later react and may abort and spread the infection in a herd. It is particularly dangerous to purchase pregnant cows from infected herds even tho they react negatively to the test. On the other hand, a breeder may purchase clean cows from clean herds in which there are no reactors and in placing them in his own herd may find that they have contracted the infection from unsuspected reactors in his own herd. Purchasing from clean herds (as determined by the agglutination test) for additions to a clean herd is recognized as a safe procedure, but purchasing cows from clean herds to recruit untested herds or herds known to contain reactors often results in the contracting of the disease by the newly purchased animals.

Is the milk agglutination test a reliable agent in detecting infected animals? The milk test, as stated on page 16, is not so reliable as the blood test. A positive reaction indicates infection just as does the serum agglutination test, but some animals that give a positive reaction to the blood test give a negative agglutination test with milk.

Does the agglutination test ever fail to detect infected animals? Yes. Occasionally heifers or cows heavy with calf may be infected and fail to react until after calving. These infected nonreacting animals are the exception. Some infected animals are slow in developing agglutinins, and animals that have been infected for many years may give an atypical or slight reaction.

Is more than one agglutination test required? Yes. It is advisable to retest all nonreacting animals in a herd at intervals of 30 to

60 days until two negative tests on the clean unit are obtained. After a herd has proved clean, annual tests seem to be sufficient.

Does the degree of agglutination remain the same in all tests applied to each infected cow? No. The degree of agglutination may vary in successive tests, but such variation is not an indication of the relative severity of the infection.

How is it that a negatively reacting animal may suddenly become positive to the test? The period elapsing from the time infection enters the mouth with food or water until the blood test becomes positive varies from two to five weeks. This incubation period may explain a positive test following a negative test.

Do all cows that react to the abortion test abort? No. All infected animals do not abort. They may calve at full term and spread Brucella Bang infection.

In one herd of reactors where approximately one-half of the animals aborted one or more times in a period of five years, 30 animals, or 47.6 percent, that reacted to the agglutination test never displayed evidence of abortion. Such infected animals are a source of danger in spreading the disease.

Do all cows that abort react to the agglutination test? No. Abortion in some animals is not caused by Brucella Bang. Moreover, a few cows that abort from Brucella Bang do not react for a period of one to three weeks later. Only very rarely, however, will an infected animal consistently fail to react.

TESTING AND ACCREDITING HERDS

How is the blood collected? Blood is taken from the jugular vein, aseptic precautions being observed as described in Circular 348 of the Illinois Experiment Station. Veterinarians should be employed to do this work.

Where are blood samples sent for testing? Consult a graduate veterinarian regarding the collection of blood samples, and arrange with him to test the samples or to send them to the Laboratory of Animal Pathology and Hygiene, University of Illinois, Urbana. Note the application blank attached to Project 1046 (pp. 26-27), copies of which can be obtained by addressing the Laboratory of Animal Pathology.

Who issues abortion-free accreditation certificates? The certificates are issued by the Chief Veterinarian of the State Department of Agriculture, Springfield, Illinois. The University has no jurisdiction in regulatory matters but is responsible for the investigational or research aspects of bovine infectious abortion.

How long may a herd remain accredited? Just as long as it remains free from abortion, as judged by yearly tests.

HANDLING OF REACTORS

What are doubtful reactors? An animal whose blood serum agglutinates Brucella Bang in a dilution of 1 part of blood serum to 50 parts of bacterial suspension, but tests negative in a dilution of 1 to 200, is a doubtful reactor. Doubtful reactors should be handled as actual reactors until subsequent tests show definitely the presence or absence of the disease.

How should aborting cows be handled? An aborting cow should be removed from the herd and placed in separate quarters. At time of abortion the infection may be given off from the genital tract. The fetus and fetal membranes should be burned and the place where the abortion occurred thoroly cleaned and soaked with a disinfectant. If the cow retains her placenta, she should be placed under the care of a trained veterinarian. Aborting animals should not be returned to the herd for two months and not then if there is any evidence of discharge from the vagina.

Can reacting cows be kept in a herd without spreading abortion to susceptible animals? Yes. In some herds under observation for a period of four years, temporary isolation at calving time has apparently prevented the disease from spreading. Success probably depends upon the virulence of the infection and the efficiency of isolation. The keeping of infected cows indefinitely is not recommended.

How may an owner get the most out of reacting cows? He may sell them for beef or put them in permanent isolation, or practice temporary isolation. A small number of reacting cows that breed normally may be kept with a reasonable degree of safety provided temporary isolation at calving time is rigidly followed. In some herds containing a limited number of reactors of unusual value it may be a distinct advantage to practice temporary isolation rather than to dispose of animals immediately. There is always an element of danger, however, in keeping any reactors.

When should reacting or aborting cows be bred? Reacting or aborting animals should not be bred until after passing three normal heat periods. This practice tends to minimize the danger that is involved in breeding cows that show inflammation of the genital tract as evidenced by discharges.

Can the agglutination test be employed to detect the presence of infectious abortion in swine? Yes. Sows and boars if infected react the same as cows.

Do all reacting sows abort? No. As in cattle, sows may develop a tolerance to the disease and carry their litters full time. (See Illinois Experiment Station Bulletin 343.)

SANITARY MEASURES

How should contaminated premises be disinfected? The place where abortions occur should be cleaned and disinfected. Aborted materials should be burned. If the abortion occurs in the pasture, the area should be thoroly sprinkled with dehydrated or quick lime. Abortions occurring in the stable necessitate the thoro cleaning and disinfection of all stalls and runways. In disinfecting a stable it is im-

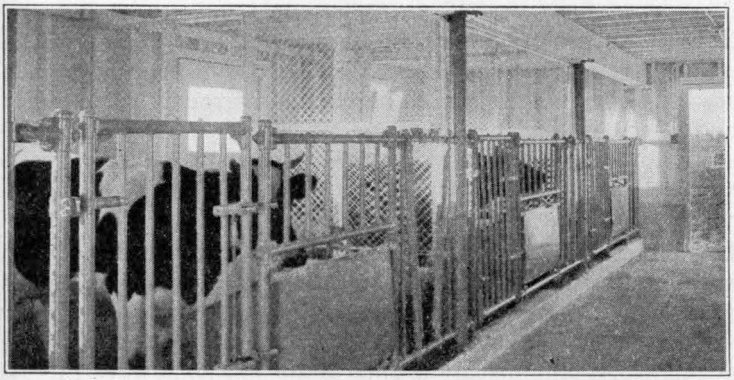

FIG. 12.—LIGHT, AIRY, WELL-VENTILATED ISOLATION STALLS FOR REACTING ANIMALS at CALVING TIME

It is a good precaution to isolate all animals at calving time, but preference should be given to reactors for the reason that they may be spreaders of abortion. After a period of 60 days, reactors, if not discharging, may be returned to the herd. The stall should be disinfected before it is occupied by other animals. Isolation quarters need not be extravagantly equipped. One end of the milk stable has been employed on some farms. Box stalls in the horse barns may also be used for isolation purposes.

portant to clean thoroly the floors, sidewalls, gutters, and mangers with one pound of lye to 40 gallons of boiling hot water before the disinfectant is applied.

What disinfectant should be used? Compound creosol (U.S.P.) 3 percent, or its germicidal equivalent, should be used. The chlorin preparations described in Circular 332 of this Station are efficient and advantageous for the reason that milk does not absorb the odor.

Should bulls or cows be douched before or after breeding? In special cases, depending upon the condition of genital organs, douching is desirable, but as a general procedure it is not regarded as an essential prophylactic in abortion-disease control.

Where should animals be bred? On ground not used for grazing cattle.

What is meant by temporary isolation? The isolation of reacting cows at calving time for two weeks before and two months after calving (Fig. 12).

Where can reactors be placed after removal from temporary isolation? They can be allowed in pastures with nonreacting cows.

What are the reasons for temporary isolation? At calving time Brucella Bang may be discharged from the genital tract of normally calving infected cows. By isolating at this dangerous period, the infection may be confined to limited quarters, where it can be destroyed.

How should isolation quarters be disinfected? After each animal is removed from isolation, the quarters should be thoroly cleaned and disinfected. The manure should be placed on ground not used for cattle, and after cleaning the floors and sidewalls with a boiling hot solution of lye water (1 pound of lye to 40 gallons of water), a standard disinfectant, such as compound creosol (U.S.P.) or its germicidal equivalent, should be used as a spray.

Are signers of Project 1046 obligated to carry out the sanitary measures outlined in this project? No. The sanitary measures are suggested as a protection to the owner. Owners at any time may withdraw from the project or disregard the recommendations made regarding the control of the disease in their herds. It is, however, to the advantage of the owner to have the herd tested and to employ essential sanitary measures in stamping out the disease.

Should normally breeding reacting animals be kept in the same pastures and barns with nonreacting animals? It is not advisable, but available data suggest that the practice may be followed on a limited scale if the animals are segregated before and after calving time.

Should reacting cows be disposed of in all cases? What to do with reacting cows depends upon the breeding conditions and the milk yield. If only a few reactors are found, and they are not good producers, they should be disposed of. It is possible, however, by practicing temporary isolation to keep a few reacting cows in a herd without spreading the disease. If a large percentage of the normally breeding animals are infected, they probably should be replaced by nonreacting animals unless ample facilities for isolation can be provided for reacting animals at the time of calving. It is possible to raise abortion-free calves from infected cows by properly isolating them.

PREVENTIVE AND CONTROL MEASURES

Can Bang disease be wiped out of a herd by selling aborters? Selling aborters removes but a part of the cows in a herd capable of spreading infection and is therefore seldom effective in cleaning up a

herd. Infected cows that breed normally may be spreaders at the time they calve. Selling both aborters and others shown by the agglutination test to be infected has successfully eliminated the disease in different herds.

If a breeder is not ready to test, what general measures may he adopt to protect his herd against the spread of this disease? Much can be accomplished in the way of management which will keep susceptible animals away from infected animals. All animals that have aborted even tho they breed normally should be regarded as infected and should be handled as potential spreaders of the infection at calving time. Aborters should be carefully isolated at calving time in order to prevent infection from being scattered in the pasture. Keeping the heifers away from the mature infected animals is also a desirable protective measure. Calves that are fed raw milk from reacting cows, even tho they seldom contract a permanent infection, should be regarded as temporary spreaders of the disease and not allowed in quarters where susceptible breeding animals are kept.

Is vaccination effective? There is little doubt that vaccines may partially immunize some animals, but it is also possible that living-culture vaccines may perpetuate the infection in a herd. Inoculation with living-culture vaccine causes all treated animals to react to the abortion test for varying periods of time, thus interfering with their sale value and making eradication methods based upon the agglutination test impracticable. At the present time vaccines should be regarded at best as experimental. Vaccinated herds are not adapted to the sanitation plan of controlling the disease.

Can the disease be cured with drugs? There is no evidence to show that there is any drug that will cure or prevent the development of abortion, and remedies advertised as cures or preventives for abortion are misrepresented.

Will medicines correct breeding troubles caused by infection of the genital tract? In some cases early treatment in skilled hands is helpful. As a general rule extended treatments do not pay. If the difficulty is not self-corrected following rest, it is generally advisable to consult a veterinarian or dispose of infected animals to the butcher.

Do mineral mixtures fed to cattle prevent Bang-abortion infection? So far as known, no mineral or combination of minerals prevents the spread of infectious abortion or cures infected animals. In the prevention of all contagious diseases properly balanced rations should be fed, but there is no mineral feed known that possesses any specific properties that aid in preventing bovine infectious abortion.

DANGER TO OTHER ANIMALS

Are swine susceptible to Brucella Bang? Judging by the agglutination test, infection may be transmitted experimentally to sows, but in natural outbreaks of swine abortion Brucella Traum, which resembles Brucella Bang, is generally involved. Brucella Traum belongs to the same group, or genus, and resembles Brucella Bang but is a separate and distinct microorganism. There is an element of danger in feeding raw milk from infected cattle to pregnant sows, yet in many outbreaks of abortion in swine coming to the attention of the Illinois Experiment Station none have been definitely traced to Brucella Bang.

Experimental evidence suggests that chickens may also be susceptible to virulent bovine strains of the abortion organism.

Do sheep contract abortion from infected cattle? No. These animals are highly resistant to bovine infectious abortion. A type of infectious abortion has been encountered in sheep but it is seldom related to bovine infectious abortion.

Is bovine infectious abortion communicated to mares? A few cases are on record of mares suffering with bovine infectious abortion, but the majority of abortions occurring in mares have no connection with Brucella Bang. Experimental data, however, point to the possibility of a Brucella species being the cause of some types of fistula, and poll evil, in horses.

Are goat and swine strains of Brucella transmitted to cattle? A few cases of infection with *Brucella melitensis,* the goat strain which causes Malta fever in man, and Brucella Traum, which causes the disease in swine, have been reported in cattle. While the abortifacient properties of these organisms to cause abortion in cattle have been demonstrated in experiments, it seems very doubtful that they are common causes of the disease in cattle.

BRUCELLA INFECTIONS IN MAN

Does pasteurization destroy Brucella Bang in milk? Yes, provided pasteurization is carefully done. Thirty minutes at 145° F. (63.9° C.) is sufficient.

Should raw milk from abortion-infected cows be regarded as dangerous for human food? It is potentially dangerous. Virulent strains might infect man following continuous ingestion. A disease known as undulant fever in man is sometimes caused by Brucella Bang. Compared with the number of persons that consume raw milk, however, there are but few known cases of undulant fever traceable to this organism. Relatively few persons seem susceptible, or it may

be that undulant fever is not yet generally recognized. The danger to man from virulent Brucella organisms in milk can be eliminated by efficient pasteurization.

In what part of the milk is Brucella Bang found in largest numbers? When milk is infected, cream contains relatively larger numbers of the organism than skim milk.

Is undulant fever in man always traceable to milk from infected cattle? No. While some cases of undulant fever in man are probably associated with drinking infected cow's milk, the evidence suggests that the porcine or swine strain is a more common cause of undulant fever in Illinois and other mid-western states.

VETERINARY SUPERVISION

A study of aborted materials from different herds suggests that a small percentage of bovine abortions may be traceable to causes other than the infection by the Bang bacillus. Abortions due to other causes appear in the minority, but nevertheless they are of practical as well as scientific importance.

Vibrio fetus, Aspergillus, *B. pyogenes,* avian tubercle bacillus, Mucor species, *Streptococcus alpha* and *gamma* and other pus-producing organisms have been found but they have not proved highly contagious. Poisonous plants have also been suspected as possible causes of abortion in some herds. Abortions due to these causes and to falls, kicks, crowding, eating of moldy feed, and drinking of cold water may be numerous enough to be important, but they make up only a relatively small percentage of the total abortions in cattle. So far as known, Brucella Bang is the most important causative factor in abortion disease in cattle. A small percentage of animals may abort in a Bang-free herd. These abortions are traceable to other causes than the Bang organism.

The Illinois Agricultural Experiment Station cannot supervise directly or make bacteriologic examinations of aborted materials from all the herds enrolled in Project 1046; yet thru the assistance of the local veterinarian, owners can have their herds tested, and by judiciously practicing the sanitary measures outlined in Project 1046 the disease can be stamped out and infection eliminated. The practice of raising calves dropped by infected and noninfected cows in isolation may be regarded as a practical and profitable procedure for some owners in establishing abortion-free herds.

PROJECT 1046

ABORTION DISEASE CONTROL

University of Illinois
Agricultural Experiment Station
Laboratory of Animal Pathology and Hygiene

OBJECT

(A) To determine if repeated agglutination tests followed by permanent or temporary isolation of reactors and disinfection of premises are practicable in the control of abortion disease caused by Brucella Bang. (B) To determine the extent of infectious abortion in cattle not related to Brucella Bang.

PLAN

1. **Making the Abortion Test.** The initial agglutination test for infectious abortion will be applied to privately owned herds at a charge of 50 cents a sample; retests to be made for 15 cents a sample. The sterile vials will be furnished by the Laboratory of Animal Pathology and Hygiene. Blood samples are to be collected by the local veterinarian at the expense of the owner. Each vial is to be labeled according to the number of the animal. The samples are to be drawn and the field, or rapid, test applied by accredited veterinarians according to instructions in Illinois Agricultural Experiment Station Circular 348.

2. **Guarding Abortion-Free Herds.** Healthy herds are to be tested annually. No animal is to be brought into the herd without a negative abortion test and a 60-day retest. Newly purchased pregnant heifers or pregnant cows are not to be allowed to enter clean herds until after calving, followed by two negative tests at intervals of 30 days.

3. **Disposition of Reactors in Infected Herds.** Animals in herds reacting to the abortion test are to be placed in temporary or permanent isolation or sold for beef. Temporary isolation will consist of separate quarters for two weeks before and two months after calving. Permanent isolation will consist of continuous separate quarters and separate caretakers. Normally breeding reacting animals are to be sold to the butcher, isolated temporarily, or placed in permanent isolated quarters, according to the owner's choice.

4. **Disinfection Following an Abortion.** Any animal which aborts in a herd is to be immediately isolated for 60 days. The place where the abortion occurred is to be cleaned and disinfected and the fetus and membranes immediately disposed of by burning. Barns are to be cleaned and disinfected at intervals of six months. Compound creosol U.S.P., or its germicidal equivalent, is to be employed.

5. **Separate Quarters for Calves.** Calves from reacting and nonreacting cows after weaning are to be kept in separate quarters and not allowed to come in contact with mature cows, bred heifers, or heifers approaching breeding age.

6. **Use of Bulls.** Bulls reacting to the abortion test are not to be used for breeding. Clean bulls are to be used on normally breeding, nondischarging reactors, and on nonreacting cows in herds where temporary isolation is practiced. Interherd use of bulls, except in clean herds, is to be discouraged.

APPLICATION FOR ENROLLMENT IN PROJECT 1046

I desire to enroll my herd in the above Project 1046, ABORTION DISEASE CONTROL. My herd consists of the following cattle:

.....

.....Purebreds..... Grades.....Total.....

Females over one year of age..... Males over one year of age.....

Females under one year of age..... Males under one year of age.....

Predominating breed.....

Date.....193..... Owner.....

Address.....

Name and address of my veterinarian:

.....

(Name)

.....

(Address)

Copies of the above project and enrollment blanks can be obtained from the Laboratory of Animal Pathology and Hygiene, University of Illinois, Urbana, on request.

See pages 19 and 20 of this circular for information concerning testing and accrediting herds and page 25 concerning necessary veterinary supervision. Recommendations regarding the disposition of reacting animals are discussed on page 20.

EMBARGO ON CATTLE SHIPPED INTO ILLINOIS

A PROCLAMATION
BY THE GOVERNOR OF ILLINOIS

WHEREAS, the Department of Agriculture has ascertained that infectious abortion or Bang disease exists among cattle and is a dangerously infectious and communicable disease, causing great losses to the cattle industry within the State of Illinois:

NOW THEREFORE, by virtue of authority vested in me by the statutes, I, Louis L. Emmerson, Governor of the State of Illinois, do hereby declare an embargo upon the entry of cattle into the State of Illinois subject to the regulations and exemptions contained herein, same to be in force and effect on and after the Fifteenth day of May, One Thousand Nine Hundred and Thirty:

(1) Except as otherwise provided, all dairy and breeding cattle more than four (4) months old brought into the State of Illinois or shipped from public stock yards within the State shall be accompanied by a certificate approved by the Live Stock Sanitary Officials of the State of origin showing the cattle to have passed a negative agglutination blood test for infectious abortion or Bang Disease within thirty (30) days prior to entry into the State. Tests will not be accepted if conducted within fifteen (15) days after having calved.

(2) A—Dairy and breeding cattle consigned to public stock yards within the state may enter without test.

B—Dairy and breeding cattle from "Bang Abortion-Free Accredited" herds may enter without test when accompanied by a certificate issued by the Live Stock Sanitary Officials of the State of origin showing such cattle to have originated in a "Bang Abortion-Free Accredited" herd.

C—Dairy and breeding cattle consigned to public sales within the State may enter without test, but such cattle as remain within the State shall be immediately subjected to the test.

D—Cattle for feeding and grazing purposes only, may enter the state or be shipped from public stock yards within the state without test, but shall be held in quarantine during the feeding and grazing period.

IN WITNESS WHEREOF, I have hereunto set my hand and caused the Seal of the State of Illinois to be affixed.

Done at the Capitol in the City of Springfield this fourteenth day of April in the Year of Our Lord One Thousand Nine Hundred and Thirty and of the State of Illinois the One Hundred and Twelfth.

(Signed) LOUIS L. EMMERSON
Governor of the State of Illinois

ILLINOIS RULES AND REGULATIONS GOVERNING ABORTION CONTROL

State of Illinois
Department of Agriculture
Department of Agriculture Order No. 24
Division of Animal Industry Order No. 14

Section One

A. "Bang Disease" or "Bovine Abortion Disease" shall mean the disease wherein an animal is infected with "Bang Bacillus," irrespective of the occurrence or absence of an abortion.

B. An animal shall be declared affected with "Bang Bacillus" if it has given a positive reaction to the "Blood Test" or any other recognized and commonly accepted test for the detection of "Bang Disease" or "Bovine Abortion Disease," or if the "Bang Bacillus" has been found in the body or in the body secretions or discharges, or if it has been treated with a live culture of "Bang Bacillus."

C. An "Abortion Free Accredited Herd" is one in which at least two annual, or three semi-annual, tests have been conducted and no reactors discovered. The last test must have been conducted by a laboratory approved by the Department of Agriculture. Additions to an Abortion Free Accredited Herd must show a negative blood test followed by a negative 60-day retest, except that in no case shall pregnant cows be added to Abortion Free Accredited Herds on the above basis. Such pregnant cows shall be maintained in isolation until after calving, at which time two negative blood tests at 30- to 60-day intervals shall be required. An annual negative blood test of all animals over six months of age in Abortion Free Accredited Herds is essential to the continuation of Abortion Free Accreditation.

Section Two

A. All diagnostic tests conducted for the detection of "Bang Disease" or "Bovine Abortion Disease" shall be conducted by a State approved laboratory or by a veterinarian approved by the Department of Agriculture and shall be immediately reported in writing, by a person who shall have made said test, to the Department of Agriculture. This report shall contain a statement of results obtained in at least two dilutions; and, for the purpose of identification, the name and address of the owner, together with a complete description of each and every animal so tested; said description must include the color and markings; predominating breed; approximate age and weight; and the number of ear tag, unless such animal is a purebred and registered animal, in which case the name and registration number shall be sufficient.

B. No herd shall be officially tested under State supervision for accreditation by the State Department of Agriculture or its representatives that has been injected with a "Live Abortion Vaccine" until a period of at least one year following said injection, nor in less than six months following the injection of killed abortion cultures, so-called abortion bacterins or sero-bacterins.

C. No accredited veterinarian shall inject cattle with a "Live Abortion Vaccine" without first testing the herd by the agglutination method to determine the extent of the infection. Treatment of a herd following the test shall be accompanied by proper explanation to the owner of the limitations of treatment.

D. "Live Abortion Vaccine" and antigen sold in Illinois by commercial manufacturers shall be reported to the State Department of Agriculture.

E. Accredited veterinarians shall promptly report all cattle injected with "Live Abortion Vaccine," including name and address of the owner of said cattle.

Section Three

A. Animals infected with "Bang Disease" or "Bovine Abortion Disease" as defined in sections one and two, shall be disposed of as follows:

(1) Under permit from the Department of Agriculture, they may be sold for immediate slaughter.

(2) Under permit from the Department of Agriculture, they may be sold to enter other herds already known to be infected with "Bang Disease" or "Bovine Abortion Disease," and remain under quarantine.

(3) Under permit from the Department of Agriculture, they may be maintained in cooperation with what is designated "Abortion Control Project 1046" of the Illinois Agricultural Experiment Station.

STUART E. PIERSON,
Director of Agriculture

D. W. ROBISON,
Supt. of Dept. of Animal Industry

W. H. WELCH,
Chief Veterinarian

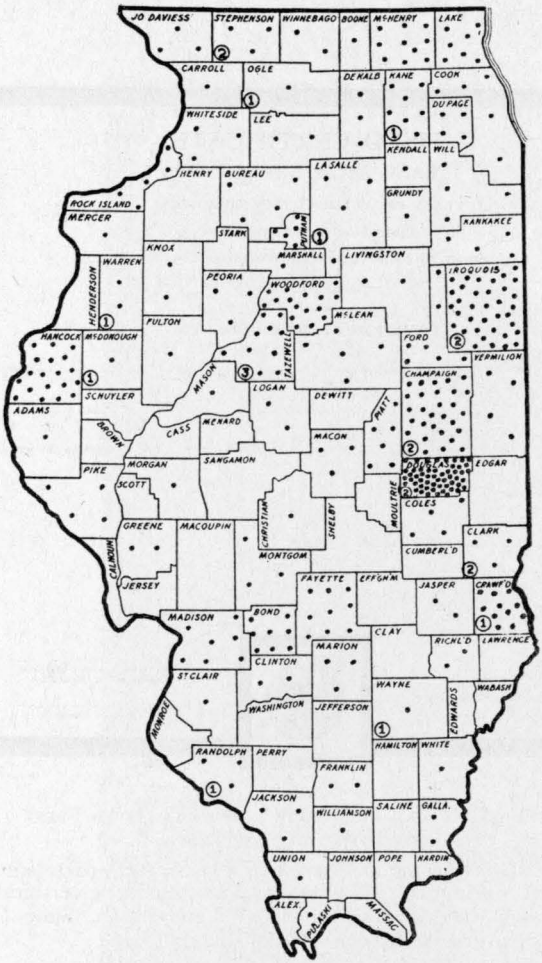

FIG. 13.—ILLINOIS COOPERATORS IN PROJECT 1046

Up to August 1, 1930, there were 365 cooperators in 68 counties of the state, indicated by the small black dots on the map. The numbers in circles represent the abortion-free accredited herds which, at that time, totaled 21 for Illinois.

HERD CERTIFICATE

BANG ABORTION DISEASE

STATE DEPARTMENT OF AGRICULTURE

DIVISION OF ANIMAL INDUSTRY

OFFICE OF CHIEF VETERINARY SANATORY INSPECTOR

Springfield, Illinois

TO WHOM IT MAY CONCERN:

THIS IS TO CERTIFY that the herd, consisting of _____ (Number and description of animals) cattle,

owned by _____ (Name) (Address)

at _____ (Location of herd) is a Bang Abortion-Free Herd, as judged by the results

of agglutination test.

This certificate is good for one year only, expiring _____ 19__

unless revoked at an earlier date.

No. _____

_____
Director,
State Department of Agriculture,
Springfield, Illinois.

_____
Chief Veterinary Sanatory Inspector,
State Department of Agriculture.

_____
Veterinarian in Charge.

FIG 14.—FORM OF CERTIFICATE SHOWING A HERD FREE FROM INFECTIOUS ABORTION

All herd certificates are issued by the State Department of Agriculture, Springfield, Illinois. Inquiries regarding certificates of herds should be sent to the Chief Veterinarian, State Department of Agriculture, Springfield, Illinois.